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Back Pain in the U.S. Army Aviation Community

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Introduction

The objective of this study was to evaluate back pain affecting military aircrew with respect to aircraft type, physical duty position of crewmembers within type (cockpit or cabin), onset and intensity of pain, hours flown within type, and crew perceptions of potential exacerbating factors, mitigating strategies, and ergonomic design. This was an exploratory, correlational survey study designed to evaluate the presence of patterns and relationships which may require further examination in understanding causal factors contributing to back pain in aircrew.

Four hundred sixty-seven (467) anonymous written surveys were distributed to U.S. Army rated and nonrated, active-duty, National Guard, and Army Reserve crewmembers (444 males and 23 females) yielding a 98% response rate. The survey included feedback on crewmember demographics, flight hours, history of back pain, approaches to management, and possible non-operational contributors to back pain. Participants were also asked to provide narrative feedback on their perceptions of aircraft seating and quality of cockpit ergonomics. Of particular interest are possible correlations among crewmember demographics, aircraft flight hours, and metrics of back pain related to flying duties specific to the four main operational platform types used within the U.S. Army: UH-60 Blackhawk, AH-64 Apache, OH-58D Kiowa Warrior, and CH-47 Chinook. Results of this study may inform future directions for aeromedical research.

Background

Back pain has remained an issue of malcontent among rotary-wing aircraft crewmembers for decades. Studies indicate that back pain occurs in the majority of military helicopter pilots with potential deleterious effects on performance, safety, and operational readiness (Gaydos, 2012). Although often minimized or underreported, back pain is targeted as one of the most common symptoms experienced by military aircrew members across all aviation platforms, suggesting a variety of causal factors including maladaptive posture (Bridger, Groom, Jones, Pethybridge, & Pullinger, 2002), whole body vibration (Hill, Desmoulin, & Hunter, 2009), inadequate lumbar support in aircraft seating (Winfield, 1990), and others. However, among a host of potential physical, occupational, and psychosocial confounders, clear lines of causation can be difficult (Gaydos, 2012). In many cases, it remains unclear exactly what modifications to aircraft design, and more specifically to which aircraft types, could potentially alleviate back pain and/or improve long-term musculoskeletal outcomes in military pilots and crewmembers (Bongers, Hulshof, Dijkstra, & Boshuizen, 1990; Froom, Hanegbi, Ribak, & Gross, 1987; Nevin & Means, 2009). Many important factors such as airframe and seat design, cockpit ergonomics, control geometry, personal life support equipment, and other engineering specifications have been driven primarily by airworthiness requirements and crash performance rather than concerns for crewmember health and comfort. For newer aircraft, there remains a paucity of data within the U.S. Army to correlate back pain with any particular seat design, aircraft type, or amount of time that crewmembers fly while constrained within such type.

Method and Materials

The study employed a 20-item questionnaire to explore the relationships between reported back pain (presence, duration, and severity), demographics, aircraft type, aircraft flight hours, and career experience and longevity. The exploratory, correlational design allowed for investigation of the relative associations between these factors as well as for providing descriptive data for newer aircraft and female pilots.

Participants

Participants ($N = 467$) were rated or nonrated U.S. Army aviation crewmembers (active-duty, Army Reserve, National Guard, and retired) over the age of 18. Recruitment occurred at the U.S. Army Aviation Center of Excellence (Fort Rucker, Alabama) from multiple Aviation Brigades, professional aviation military courses, and aviation organizational meetings. Of the participants, 24 were female and the mean age was 35.5 ($SD = 6.47$). The response rate was 97.9%.

Materials

The anonymous, paper-and-pencil administered, 20-question survey was adapted from the occupational back pain epidemiologic questionnaire published by Agius, et al. (1994). In this study, the “back” was defined as the region from the shoulder blades down to the lower region of the buttocks (consistent with definition provided in original survey version [Agius et al., 1994]). The instrument included questions regarding crewmember demographics, flight experience, history of back pain, approaches to managing back pain, and possible non-operational confounders of back pain. Participants were also asked to provide narrative feedback on their perceptions of aircraft seating and quality of cockpit ergonomics. The survey instrument is included in Appendix A.

Procedure

At the start of each recruitment session, research staff administered an orientation briefing to potential participants lasting approximately 15 minutes describing the study’s purpose and opportunity for participation. After the briefing, military leadership personnel were asked by research staff to exit the study room (those individuals were afforded a separate opportunity to participate outside the group setting), and then all individuals received the 20-question survey. Volunteers who wished to participate were given the opportunity to complete and return the anonymous, written survey to a sealed collection box placed by research staff at a designated location inside the room; individuals choosing not to participate in the survey were instructed as well to turn in the blank/uncompleted survey to the collection box in order to help maintain complete anonymity and determine response rate. The survey instrument required approximately 30 minutes to complete.

Quality Control and Statistical Analysis Approach

Data entry accuracy for the paper-and-pencil questionnaire was assessed using a 10% sample. Statistical analyses were performed using the statistical software package SPSS release 19.0.0. Descriptive statistics, nonparametric tests (Mann-Whitney U, Wilcoxon Ranked Sum Test), Spearman's rank correlation coefficients, and stepwise linear regression models were used to explore the data. Open-ended responses were reviewed for trends.

Results

The survey used in the present study was designed to describe and explore potential relationships between crewmember demographics, aircraft type, aircraft flight hours, career experience and longevity, and consequences associated with personnel afflicted by back pain and self-reported metrics of back pain as related to flying duties. Collectively, the responses to the 20 survey questions describe the reported existence of back pain as it relates to crewmember demographics. The response rate for this study's survey was 97.9%.

Descriptive statistics for the demographic data including flight status and military affiliation are presented in Tables 1 and 2 for the 467 participants, separated by gender. Table 3 presents descriptive statistics for reported flight hours by aircraft type.

Table 1. Descriptive Statistics for Demographic Data.

	Minimum	Maximum	Median	Mean (<i>SD</i> ¹)
Overall (N = 467)				
Age (years)	21	58	34	35.5 (6.47)
Height (in.)	57	77	71	70.6 (3.16)
Weight (lbs)	115	255	190	188 (24.7)
Beginning of aviation career (calendar year)	1976	2014	2006	NA
Females (n = 24)				
Age (years)	22	45	30.5	31.8 (5.72)
Height (in.)	58	70	65	65.0 (2.93)
Weight (lbs)	115	190	135	142 (20.0)
Beginning of aviation career (calendar year)	1995	2013	2007	NA
Males (n = 443)				
Age (years)	21	58	34	35.7 (6.45)
Height (in.)	57	77	71	70.9 (2.86)
Weight (lbs)	120	255	190	190.6 (22.95)
Beginning of aviation career (calendar year)	1976	2014	2006	NA

Note. ¹*SD* denotes Standard Deviation.

Table 2. Frequencies of Rated/Nonrated Crewmembers and Military Affiliation.

	All Participants	Males	Females
Rated	369	349	20
Nonrated	29	25	4
*Missing	69	69	0
Active Duty	268	250	18
Reserve/National Guard	136	130	6
Dept. of the Army Civilian	16	16	0
Contractor	2	2	0
*Missing	45	45	0

Table 3. Descriptive Statistics of Cockpit, Cabin, and Combat Hours by Aircraft Type.

Aircraft type	Hours in Cockpit		Hours in Cabin		Combat hours	
	Sum (n ¹)	Mean (SD)	Sum (n)	Mean (SD)	Sum (n)	Mean (SD)
AH-64 Front seat	64,309 (101)	636.72 (529.53)	NA	NA	46,085 (59) ²	781.1 (456.14)
AH-64 Back seat	62,942 (86)	731.88 (94.38)	NA	NA	NA	NA
OH-58	134,520 (146)	921.37 (1,038.31)	435 (12)	36.25 (33.99)	60,198 (64)	940.59 (579.37)
OH-58D	95,896 (74)	1,295.89 (1,050.28)	0	0	56,193 (57)	985.84 (578.58)
UH-1	32,511 (52)	625.21 (920.93)	3,600 (10)	360.00 (350.84)	1,219 (3)	406.33 (167.99)
UH-60	306,088 (253)	1,209.83 (920.64)	43,525 (116)	375.22 (505.82)	120,126 (204)	588.85 (399.87)
UH-72	12,068 (40)	301.70 (305.69)	675 (5)	135 (114.02)	0	0
TH-67	20,132 (200)	100.66 (105.41)	2,362 (41)	57.61 (40.18)	1,200 (1)	NA

Table 3 (continued). Descriptive Statistics of Cockpit, Cabin, and Combat Hours by Aircraft Type.

CH-47	47,618 (46)	1,035.17 (691.92)	7.513 (21)	357.76 (568.82)	23,549 (42)	560.69 (360.20)
C-12	41,697 (37)	1,126.95 (1,124.31)	535 (8)	66.88 (52.30)	10,340 (19)	544.21 (335.49)
C-21	4,095 (4)	1,023.75 (1,303.04)	0	0	100 (1)	NA
Other	57,378 (57)	1,006.63 (1,054.65)	6,125 (12)	510.42 (866.98)	10,585 (16)	661.56 (389.73)

Note. ¹n denotes the number of respondents who reported greater than 0 hours. ²Overall values for AH-64 collapsed over front and rear seat. The OH-58 A/C was used in combat during the Bosnia conflict and Operation Desert Storm. The CH-47 data is not broken out by model type given that the seat design has not been altered, but a new seat cushion was implemented in the CH-47 F model.

Collapsing over aircraft type, 395 out of 467 participants (2 missing data; 84.9%) reported having back pain at some time during their flying career while 361 participants (3 missing; 77.8%) reported pain during the calendar year preceding the survey and 40 (no missing; 8.6%) reported that they had back pain issues before starting their flying career. The mean reported time in flight before back pain began was 67.52 min (89 missing data; $SD = 54.88$, $Mdn = 60$). Of the 387 responses regarding durations of pain after cessation of a flight, the most frequently reported were “less than 2 hours” ($n = 114$ [29.46%]), “greater than 2 hours” ($n = 95$ [24.55%]), and “more than 24 hours” ($n = 92$ [23.77%]).

For female respondents, 22 out of 24 (91.7%) reported having back pain at some time during their flying career. Likewise, 21 female participants (87.5%) reported pain during the calendar year preceding the survey and 2 (8.3%) reported having back pain before starting their flying careers. The mean reported time in flight before back pain began was 55.81 min (3 missing; $SD = 40.56$, $Mdn = 45$). Chi-square tests for independence yielded nonsignificant results for these pain variables between males and females.* The most frequently reported durations of pain after cessation of a flight for females (3 missing data) were similar to those for males: “less than 2 hours” ($n = 8$ [33.3%]) and “more than 24 hours” ($n = 7$ [29.2%]).

Table 4 displays the frequencies of responses by gender to potential causes or contributing factors to back pain. Activities affected by back pain are also included in Table 4. The most frequently reported activities affected are sitting, standing, and stooping (bending over) for both males and females. Both males and females most frequently reported the amount of combat gear as a cause of back pain followed by quality of lumbar support and angle of seat. The patterns in frequencies of responses for males were similar to that for females.

*For all 3 chi-square tests run, one cell had an observed count less than the minimum expected count thus yielding potentially unreliable results.

Table 4. Frequencies of Back Pain Causes/Contributing Factors and Activities Affected, by Gender.

	All Participants (N = 398 ¹)	Males (n = 376)	Females (n = 22)
Causes/Contributing factors			
Angle of seat	224	214	10
Shape of seat	166	157	9
Seat material	201	190	11
Duty on flight controls	201	192	9
Restraint/shoulder harness	31	28	3
Quality of lumbar support	301	287	14
Amount of combat gear	314	299	15
Ability to adjust seat	205	195	10
Other	59	56	3
Activities affected			
Sitting	199	186	13
Standing	175	166	9
Walking	86	84	2
Flying an aircraft	114	108	6
Maintaining situational awareness	35	32	3
Getting out of a chair	119	116	3
Driving a vehicle	92	88	4
Stooping (bending over)	208	201	7
Other	48	44	4

Note. ¹Data were missing from 69 respondents

Participants provided ratings of their back pain before and after a flight on a scale ranging from 0 (no back pain) to 10 (worst pain). Data were missing for 74 participants resulting in 393 valid responses. The mean rating of before-flight pain was 2.03 ($SD = 1.74$, $Mdn = 2$) and the mean rating of after-flight pain was 5.20 ($SD = 2.05$, $Mdn = 5$). A Wilcoxon Signed Rank Test indicated that the median before-flight ratings were significantly less than median after-flight ratings, $Z = 16.65$, $p < 0.001$. Mann-Whitney U tests did not support any differences in ratings between males and females (before-flight ratings, $U = 4262$, $p = 0.722$; after-flight ratings, $U = 3366$, $p = 0.152$). Of the 393 participants who provided before-flight ratings, 391 also responded whether they had visited a health care provider about their back pain.[†] A comparison of median

[†]In addition, 85 respondents stated that they were receiving Veterans Affairs disability benefits for flight related back pain. Note that only 10 of the respondents based on reported military affiliation could be qualified to receive such benefits (Department of the Army Civilians and contractors that are retired or separated from the military),

values indicated that those who had seen a provider reported greater before- and after-flight back pain than those who had not, $U = 25,405, p < 0.001$, and $U = 25,003, p < 0.001$; respectively (Table 5). Finally, of the 395 valid responses, 61 (15.44%) indicated ~~that he/she had having~~ been grounded or missed work due to back pain (56 males, 5 females). Again, comparisons of the median values suggested that those who had been grounded/missed work rated their back pain as greater than those who had not been grounded/missed work both before and after flight, $U = 12,698.50, p < 0.001$, and $U = 12,229, p = 0.005$; respectively (Table 5).

Table 5. Descriptive Statistics for Before- and After-Flight Pain Ratings.

	Mean	SD	Median
Before-flight pain ratings			
Visit to health care provider	210	2.50	1.83
Did not visit provider	181	1.50	1.44
After-flight pain ratings			
Visit to health care provider	210	5.72	6.00
Did not visit provider	183	4.63	5.00
Before-flight pain ratings			
Grounded/missed work	60	2.68	1.66
No work disruption	330	1.93	1.72
After-flight pain ratings			
Grounded/missed work	60	5.90	6.00
No work disruption	332	5.10	5.00

With respect to reported back pain and demographics, no difference was seen in a comparison of median values between rated and nonrated crew.[‡] Height and weight were not significantly correlated to back pain ratings, pain onset, pain duration, or medical outcomes (health care provider visit, grounded from flight). Age was weakly correlated with back pain ratings after-flight; $r_s(395) = 0.147, p = 0.003$; pain onset in flight, $r_s(378) = -0.128, p = 0.013$; and experienced grounding for back pain, $r_s(395) = 0.210, p < 0.001$. Given that age is strongly correlated with total flight hours ($r_s(461) = 0.507, p < 0.001$) and years of experience ($r_s(464) = 0.687, p < 0.001$), it is difficult to delineate the unique relationships between pain and each of these variables. Thus, stepwise linear regression models were explored. The first model entered the age, total flight time, and years of experience as predictors and reported after-flight pain rating as the outcome variable. The results suggest that age explained a statistically significant amount of the variance in after-flight

suggesting that participants were unclear on what constituted disability benefits. It is quite possible that the unlikely number of people who responded in this manner are active-duty and reserve component military members receiving medical care (not disability) at a VA medical center.

[‡] Note that the difference in sample size between rated and nonrated crew is very large thus limiting the interpretability of this finding.

pain ratings ($R^2 = 0.011$, $F(1, 387) = 4.12$, $p = 0.043$). Likewise, age significantly predicted after-flight pain ratings ($\beta = 0.033$, $t(387) = 2.03$, $p = 0.043$). The second model used the same three potential predictors to model the amount of time into flight when pain begins and similarly found that age explained 1.5% of the variance ($R^2 = 0.015$, $F(1, 370) = 5.45$, $p = 0.02$). Again, age was a significant predictor of pain onset in flight ($\beta = -1.03$, $t(370) = -2.33$, $p = 0.02$).

Participants were asked to indicate methods/techniques used to reduce back pain prior to flight. Table 6 summarizes the frequencies of these responses, by gender. The most frequently reported methods for both males and females are stretching/exercise (75.88%), medication (45.47%), and lumbar/back support (31.16%).

Table 6. Frequencies of Efforts to Reduce Back Pain Prior to Flight, by Gender.

	All Participants (<i>N</i> = 398 ¹)	Males (<i>n</i> = 376)	Females (<i>n</i> = 22)
Nothing, not doing anything for back pain	47	44	3
Personal seat cushion	72	70	2
Lumbar/back support	124	117	7
Unit-provided seat cushion	33	30	3
Unit-provided lumbar/back support	17	16	1
Stretching/exercise	302	376	22
Medication	181	172	9
Heating pad	84	78	6
Other ²	55	53	2

Note. ¹Data were missing from 69 respondents

²Data were missing from 70 respondents (*N* = 397)

To compare reported presence and degree of pain between aircrew in the four main U.S. Army rotary-wing aircraft platforms, respondents were categorized according to the number of flight hours reported for each platform by cockpit, cabin, and combat hours. Respondents reported hours in multiple aircraft platforms and thus were categorized by the platform in which they had the most flight hours. For the purposes of categorization, hours in different models (UH-60 A/L and UH-60 M) were summed to arrive at a total for each platform. Descriptive statistics are provided in Table 7 for categorized aircraft by cockpit and combat hours. Cabin hours did not yield groups large enough for comparison. Given the large differences between sample sizes in each category, nonparametric tests were used to compare distributions and medians. The results show that the median pain after flight was different among the aircraft platforms categorized using combat hours ($\chi^2 = 8.60$, $p = 0.035$). Pairwise comparisons ($p < 0.05$), using the Median test, show reported pain is greater in AH-64 and CH-47 pilots than UH-60 and OH-58 pilots. Likewise, median pain after flight was different (marginally significant) among the aircraft platforms categorized using cockpit hours ($\chi^2 = 7.54$, $p = 0.056$).

Inspection of the medians suggests greater pain in OH-58 pilots than the other platforms. All other comparisons were not significant.

Table 7. Descriptive Statistics for Before- and After-Flight Pain Ratings by Aircraft Platform.

	<i>n</i>	Mean	<i>SD</i>	Median
Before-flight pain ratings				
AH-64 cockpit	69	2.03	1.33	2.00
AH-64 combat	52	2.13	1.40	2.00
UH-60 cockpit	191	2.23	1.87	2.00
UH-60 combat*	165	2.30	1.97	2.00
CH-47 cockpit	36	1.78	1.29	2.00
CH-47 combat	35	1.83	1.27	2.00
OH-58 cockpit	72	1.65	1.54	2.00
OH-58 combat	56	1.61	1.56	1.50
After-flight pain ratings				
AH-64 cockpit	70	5.24	1.85	5.00
AH-64 combat	53	5.43	1.92	6.00
UH-60 cockpit	192	5.28	2.10	5.00
UH-60 combat**	165	5.29	2.19	5.00
CH-47 cockpit	36	5.33	2.04	5.00
CH-47 combat	35	5.37	1.99	6.00
OH-58 cockpit	72	4.90	1.92	6.00
OH-58 combat	56	4.86	1.87	5.00
Time into flight pain begins (minutes)				
AH-64 cockpit	70	73.49	55.42	60.00
AH-64 combat	53	76.60	57.78	60.00
UH-60 cockpit	184	70.67	58.69	60.00
UH-60 combat	157	64.93	48.75	60.00
CH-47 cockpit	36	57.50	46.50	45.00
CH-47 combat	35	54.43	46.27	45.00
OH-58 cockpit	66	65.24	52.73	60.00
OH-58 combat	51	71.71	54.26	60.00

Note. ¹Spearman rank correlation coefficient significant at $p < 0.01$.

²Spearman rank correlation coefficient significant at $p < 0.05$.

Participants responded to two open-ended questions at the end of the survey: 1) any other activities that may worsen/contribute to back pain (232 responses), and 2) opinions of the quality of aircraft ergonomics (310 responses). The most frequently reported activities that may be

contributing to back pain were exercise (47 responses, 20.26%), weight lifting (47 responses, 20.26%), and running (30 responses, 12.93%). The most prevalent responses to ergonomic concerns were seating issues (188 responses, 60.65%). Specifically, 38 responses referenced lack of lumbar support with the most complaints ($n = 14$ [5.53% of UH-60 pilot respondents]) being related to UH-60 A/L/M models. In addition, 31 responses were related to seat adjustability with 2 positive reports on the adjustability of the CH-47 D/F seats (4.3% of CH-47 pilot respondents) and one positive report on the adjustability of the LUH-72A seats. However, most responses called for seats with better adjustability with 15 complaints being leveled at the UH-60 A/L models (5.9% of respondents reporting cockpit hours in UH-60 A/L models). In general, the UH-60 A/L models received the most complaints and were generally centered on seating (42 negative responses almost exclusively to UH-60 A/L models [17.1%] and 6 positive responses to UH-60 M [6.8%] model seating). Of note, 33 individuals (11% of respondents) specifically mentioned that weight from equipment worn on the body (armor, helmets, survival vests, etc.) contributed to back pain during flight. All transcribed responses are included in Appendix B.

Discussion

Back pain is a common medical problem and remains a significant aeromedical issue with potentially serious consequences with respect to flight performance and safety, as well as occupational attrition. Because of this challenge to both maintenance of flight status and the longevity of an aviator's career, back pain in the aviation community may be underreported or unreported making it difficult for clinical researchers to quantify (Gaydos, 2012). The whole of the problem is multifactorial and exceedingly complex—and not limited to occupational exposure. Age, smoking, physical fitness, obesity, anxiety and depression, family history, previous injury, stress and workload, work satisfaction and compensation systems, as well as other factors may be at play (Dempsey, Burdorf, & Webster, 1997; NIOSH, 1997; Pope, Goh, & Magnusson, 2002). This level of complexity and number of confounders among such a common condition across the general adult population makes the issue an exceptionally difficult area of study.

This study was conducted to assist with accounting for back pain issues in general, and back issues related to specific aircraft flight duty among U.S. Army crewmembers. Statistically significant, platform-specific findings with relation to back pain severity were limited to the UH-60 A/L, C12, and OH-58 D aircrafts. The UH-60 A/L flight hours were directly related to back pain severity before flight such that pain severity increased as hours increased suggesting that overall level of experience in this aircraft may be related to back pain experienced outside of the aircraft and not immediately following flight duties. This is also reflected in the open-ended responses, where the UH-60 A/L received more complaints than any other platform: a total of 42 negative responses were almost exclusively attributed to seating in UH-60 A/L models with six positive responses to the newer generation UH-60 M seating. This is an interesting corollary to a previous study in the literature, which suggests that utility helicopter pilots report more back pain prevalence and severity (Grossman, Nakdimon, Chapnik, & Levy, 2012). However, the higher amount of responses for this platform may be a product of the fact that reported UH-60 flight hours were more than double any other platform's average flight hours per respondent. Interestingly, back pain severity was inversely related to total flight hours in the C-12 and OH-58 D aircrafts, thus indicating that pain decreased as time flown in these aircrafts increased.

In this study, age had statistically significant, but weak, correlations with back pain severity, onset during flight, and grounding. These relationships suggest that pain severity and the likelihood of having been grounded increase with age, whereas onset of pain in flight decreases with age. This may represent older aircrew who endure the pain as a fait accompli occupational nuisance. Total flight hours was not significantly related to any measures of back pain. It may be that age is a better surrogate marker of the back pain descriptors used in this study than flight hours. This is plausible considering the multifactorial etiology of back pain as advancing age captures the cumulative stress on the back from all sources (in addition to age-related physiological and degenerative changes), not just time in flight (e.g., Kienbacher et al., 2015; Quirk, Hubley-Kozey, 2014).

Unfortunately, the small sample size of females relative to that of males in this study makes it extremely difficult to draw any conclusions or interpretations based on gender differences. The sample proportion of females is reflective of the proportion of females in the total Army aviation population (personal communication, Deputy Director Army Aeromedical Activity, 2016). As such, data are presented for males and females where appropriate. It remains possible that there is a gender-related component in low-back pain that is worthy of consideration among this population at risk given findings from a study of an occupationally related surrogate population (Knox, et al., 2014) and the documented prevalence of low-back pain among females, generally (Hoy, et al., 2012). While, this study did not yield significant gender differences, this remains an area worthy of further investigation, in light of potential mitigating strategies with respect to anthropometrics and ergonomics.

The results of this survey with respect to the pervasiveness and significance of the problem mirror previous studies on the extent, effects, and factors of back pain within this community (Bridger et al., 2002; Cunningham, Docherty, & Tyler, 2010; Thomae, Porteous, Brock, Allen, & Heller, 1998). In our study, 395 (84.6%) participants responded that they have had back pain while on flight status (not necessarily in flight), with 361 (77.3%) having had back pain in the year previous to participating in the survey. While in flight, the reported median time until back pain developed was 60 min, well before the time that the majority of flight missions will be completed. Literature has indicated body armor plus full combat load and a hostile environment are risk factors for low-back pain (Knapik, Reynolds, & Harman, 2004; Quillen, Childs, & Mayer, 2013). In this community, survival equipment may exacerbate poor posture and spinal loads in seats that may have never been originally designed to accommodate a seated pilot in such a configuration. In our study, 314 respondents (67.2%) chose “amount of combat gear to include body armor” as having caused or contributed to their back pain. This was the response most often chosen, closely followed by “quality of lumbar support” (selected 301 times [64.4%]). Lumbar support concerns are in keeping with reports of back pain issues surrounding inadequate seating and unhealthy postures (Graham-Cunning, 1999; Pelham, White, Holt, & Lee, 2005; Sheard, Pethybridge, Wright, & McMillan, 1996). The fact that the top factors cited by the study population included aviation life support equipment design/integration and lumber support is of significance as these are two relatively inexpensive and permissibly correctable elements within the current state of resource and fiscal constraint.

Other interesting points from this study derive from the open-ended questions, as well. Approximately 20% of respondents attributed exercising, especially weight lifting, as worsening or contributing to their back pain. This appears to be an interesting corollary with the 302 respondents (64.6% of the total group) who chose “stretching and exercise” as a method employed to reduce pain. Given the variability in possible specific physical activities, exercise regimens, and “back health programs,” it is inappropriate to draw firm conclusions regarding this point. Open-ended questions did not provide that level of granularity. This most likely indicates that not all exercise routines have a positive effect on aviator back health.

Limitations and future studies

The findings of this study are limited for a number of reasons, some of which are inherent to the methodology employed. In particular, self-report surveys are prone to bias including recall, survival, and social desirability. In addition, some survey questions were not structured in such a way that back pain could be quantified. In other words, it is not possible to tell the severity of back pain specific to aircraft given the structure of the instrument. All respondents in this survey indicated experience in multiple aircraft platforms posing a significant challenge to isolating relationships with specific aircraft. This is common given that Army flight school uses various training helicopters before a student transitions to his or her duty aircraft and an experienced aviator transition back to training helicopters as he or she becomes an instructor. In addition, various aircrafts are phased out to be replaced by significantly newer models (i.e., UH-60 A/L to M) or completely new platforms (i.e., the UH-1 and the OH-58 are no longer part of the active-duty Army inventory, while the UH-72 was added to the inventory approximately 9 years ago).

An additional limitation of the methodology employed is the sampling method. While a very large sample was obtained for this survey, it is a convenience sample thus limiting in the generalizability of the results. In future efforts, a stratified sampling approach would increase the representativeness of the sample as well as allow for more definitive analyses to be conducted evaluating relationships and effects specific to demographics and aircraft platforms.

Finally, recommendations for future studies include questions that determine when back pain first appears in a respondent’s career and how often the back pain occurs, questions that identify body positions most likely to illicit or exacerbate pain, and questions to evaluate past medical, occupational, and recreational history more thoroughly. Attempts to create more homogenous groups of aviators among the different platforms would also be highly desirable. One way this grouping could be achieved is to restrict respondents to less than 10% of their flight hours in aircraft outside of their one, and only one, primary flight platform.

Conclusions and Recommendations

The results of this study suggest that back pain is weakly related to total flight hours in specific aircraft including the UH-60 A/L, C-12, and OH-58 D. These relationships suggest increasing pain severity with increasing time in a UH-60 A/L and decreasing severity with increasing time in the C-12 and OH-58 D. Also, age had a weak, negative correlation with time of pain onset and weak, positive correlations with pain intensity, duration, and grounding for and seeking treatment for back pain. Sitting and standing were the most frequently chosen activities

made more difficult by the respondents' back pain and "stretching and exercise" was chosen most often as a preventive strategy prior to flying. Lastly, the concerns expressed by respondents related to wearing body armor in the cockpit, lumbar support, and adjustability of seats should direct particular attention to studies that assess the potential benefit of various preventative strategies of ergonomic seat design.

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Appendix A. Survey Instrument.

This survey is strictly anonymous. Please do NOT write your name or unit on this form.

1. ***While on flight status***, please indicate your military affiliation below. Please mark **ALL** that apply.
- Rated Crewmember Department of the Army Civilian (DAC) Active Duty Military
 Non-Rated Crewmember Contractor Reserve/National Guard

2. Please indicate your **current AGE**: _____ years of age.

3. Please indicate your **GENDER**: Male Female

4. Please indicate your **current Height** _____ inches, and **Weight**: _____ lbs.

5. In what **YEAR** did you ***BEGIN*** your aviation-related duties? _____

6. Please indicate the **NUMBER OF HOURS** that you have performed duties within the ***COCKPIT*** and/or ***CABIN*** of any of the following aircraft. Also, please indicate the respective number of hours in ***COMBAT***. **Mark all that apply.** Also, please enter any **other aircraft** in which you have greater than 50 flight hours.

Aircraft	Hours in Cockpit	Hours in Cabin	Combat Hours
AH-64	Front Seat _____ Back Seat _____	N/A	
OH-58D		N/A	
OH-58			
UH-1			
UH-60 A/L			
UH-60 M			
UH-72			
TH-67			
CH-47 D			
CH-47 F			
C-12			
C-21			
Other:			
Other:			

7. Total hours of flight time (excluding simulator time): _____ hours.

7a. Hours flown in the **Last 12 Months**: _____ hours.

7b. Most hours flown in **ANY 1-Year Period** _____ hours. What year? _____
Was this combat-related? YES NO

8. ***Prior to starting your aviation career***, did you experience any chronic pain or ache in your back?

_____ YES _____ NO

9. ***At any time while on flight status***, did you experience any back pain or ache? _____ YES _____ NO

10. ***During the past YEAR***, have you experienced any back pain or ache? _____ YES _____ NO

******If you answered "NO" to Questions 9 and 10, please STOP here. If you answered "YES" to either of these questions, please continue to the next page.***

*Note: No personally identifiable information was collected with the distribution of this survey.

11. On a scale of 0 to 10 (0 = no pain or ache; 1 = the least or minimal pain or ache; 10 = the worst pain or ache), please rate your back pain or ache level below.

Back pain orache before a flight: _____ (0 to 10 scale, please see above)

Back pain orache after a flight: _____ (0 to 10 scale, please see above)

How long does your pain last after a flight: ___ <30 min; ___ <2hrs; ___ >2hrs; ___ >24hrs; _____ Other

12. How much time into a flight before your back pain/ache begins? _____ minutes

13. Please tell us if you think any of the following issues have caused (or contributed to) your back pain/ache.

Please mark all that apply and explain as necessary in the "Other" space below.

- Angle of seat Duty On the flight controls Amount of combat gear to include body armor
 Shape of seat Restraint/Shoulder harness Ability or lack of ability to adjust the seat
 Material of the seat Quality of lumbar support Other (e.g. posture, please explain below)

If Other, Please Explain: _____

14. Has your back pain/ache led to difficulty with any of the following activities? Please mark all that apply.

- Sitting Flying an aircraft Driving a vehicle
 Standing Maintaining Situational Awareness Stooping (bending over)
 Walking Getting out of a chair Other (please explain below)

If Other, Please Explain: _____

15. Since the time you started flying, have you seen a health care provider (e.g., physician, flight surgeon, chiropractor, etc.) about your back pain? _____ YES _____ NO

16. Have you ever been grounded (or otherwise missed work) because of your back pain? _____ YES _____ NO

If YES, then for how long? _____

17. If you answered "Yes" to Question 16 (above), please tell us if you are receiving any VA Disability for flight-related back pain. _____ YES (____%) _____ NO

18. What are you doing (or perhaps did in the past) to reduce the level of pain in your back PRIOR to flight? Please mark all that apply.

- Nothing, not doing anything for back pain/ache. Unit-provided seat cushion Medication (e.g., Ibuprophen, Aspirin, Tylenol, etc.)
 Personal seat cushion Unit-provided lumbar support and/or back support Heating pad to the lower back
 Lumbar/back support Stretching or Exercise Other (please explain below)

If Other, Please Explain: _____

19. Please indicate any of your other activities that you think might worsen/contribute to your back pain (e.g., exercise, weight lifting, sky diving, construction projects, weekend warrior sports activities, etc.).

20. Please give us your candid impressions or thoughts on the quality of aircraft ergonomics (e.g., seats, access to flight controls, etc.) Be sure to indicate the specific aircraft pertaining to your comments. For additional space, please feel free to use the back of this page.

*Note: No personally identifiable information was collected with the distribution of this survey.

Appendix B. Complete transcriptions of open-ended questions 19 and 20.

Question #19. Please indicate any of *your other activities that you think might worsen/contribute to your back pain* (e.g., exercise, weight lifting, sky diving, construction projects, weekend warrior sports activities, etc.).

Question #20. Please give us your candid impressions or thoughts on the *quality of the aircraft ergonomics (e.g., seats, access to flight controls, etc.)* Be sure to indicate the specific aircraft pertaining to your comments.

1. 19-Blank
20-Neck pain as well to(?) back.
2. 19-Blank
20-Blank
3. 19-Exercise, weight lifting
20-Blank
4. 19-weight lifting
20-Blank
5. 19-Blank
20-Blank
6. 19-I am not limited, I have learned to mitigate pain.
20-LUH-72A, good, very comfortable and able to adjust seats as necessary.
7. 19-Blank
20-Blank
8. 19-NP
20-AC Ergo sucks body armor sucks
9. 19-N/A
20-It is terrible
10. 19-Golf
20-I do not believe ergonomics was something important to any aircraft design.
11. 19-yard work; specially when squatting
20-OH-58: Seat back, seat mesh and should harness do not provide the best ergonomics considering the cockpit size; specially when adjusting the cyclic friction.
12. 19-Driving sports cars
20-Blank
13. 19-Blank
20-Blank
14. 19-Blank
20-Blank
15. 19-Army PRT
20-more room in the Blackhawk
16. 19-Blank
20-Blank
17. 19-Any stationary sitting for long periods results in stiffness
20-Upright seat back UH-60 encourages forward leaning/ slouching
18. 19-Blank

20-UH60 cushions are worthless and if used for any period of time becomes simply a large piece of cardboard.

19. 19-Blank

20-UH 60 M Oregon aero seats are the most comfortable seats I have used.

20. 19-Blank

20-Blank

21. 19-N/A

20-On my first deployment my unit purchased the aero seat cushions and very few of us had any back issues, but on my second deployment, we used the air-filled m-model seats and many of us experienced issues even though we only flew half as much as the first deployment, the UH-60 M-seats are horrible.

22. 19-Blank

20-Poor, I'm very hunched over the control when at the designed eye height. All ALSE gear is "hanging" poor cushions.

23. 19-Blank

20-UH60 M has improved support and helps as opposed to UH- A/L

24. 19-Blank

20-Blank

25. 19-Blank

20-UH-60M: seat cushions are inadequate and provide minimal support. Weight of body armor/flight gear cause significant stress on the lower back which is made worse by long flights. Also, flight helmet and use of NVGs also cause stress on the neck and the back.

26. 19-N/A

20-UH60M crew seats are very uncomfortable at 5+ hours of FH

27. 19-Blank

20- seat design in UH-60M, back cushion & seat cushion.

28. 19-yard work

20-UH-60M inflatable seat cushion suck.

29. 19-Blank

20-Blank

30. 19-Blank

20-UH-60

31. 19-Blank

20-Blank

32. 19-Flying!

20-UH60M—what ergonomics? Cannot tell they exist w/ level of discomfort.

33. 19-Weight lifting, back packing

20-H60M- seats are adequate, but long periods of coupled flight (aircraft flying director) means that pilots are completely sedentary (no body movements to control inputs) which I believe makes it worse (or at least you notice back pain more)

34. 19-Running

20-The gear we fly with tends to make you slouch after a few hours.

35. 19-N/A

20-H-60-too much weight worn by flight crews.

36. 19-None

20-The seat is too straight up +down and offers no lumbar support

37. 19-Blank
20-Blank
38. 19-Blank
20- Seat back cushion are not used with combat gear very much
39. 19-lots of heavy lifting
20-Blank
40. 19-Parachute jumping, weightlifting
20-Blank
41. 19-Blank
20-UH60M, the seat is vertical, with body armor on forces you to lean forward.
42. 19-Blank
20-Blank
43. 19-none
20-Better ALSE gear- plate carrier (Eagle Vest for everybody)
44. 19-Blank
20-Blank
45. 19-Blank
20-Blank
46. 19-Typing at a computer for hours
20-The UH-60M had seats that adjusted that helped significantly. Pain experienced in the UH 60M was from high flt hrs and heavy gear. Flights in the OH-58 are painful because the seats won't adjust.
47. 19-Blank
20-Material of seat cushions seems to have greatest impact. Old foam cushions are poor-newer memory foam seems to alleviate discomfort.
48. 19-Airborne status for 8 years with 75 jumps.
20-CH-47F seats are uncomfortable and won't adjust to a better seating position, could be caused by smaller cockpit on new fox models.
49. 19-PRT PT
20-Seats are super bad. If a car had seats that bad I would not buy.
50. 19-Blank
20-H47 Poor lumbar support
51. 19-Blank
20-Blank
52. 19-Blank
20-Pivoting crewmember seating in cabin.
53. 19-Blank
20-CH47F- material particularly in seat wears down, causes lean into the center of the aircraft (towards center console)
54. 19-running
20-Blank
55. 19-weight lifting running
20-Blank
56. 19-Living
20-good for CH-47
57. 19-construction

20-seat cushions-I don't think they are designed to accomodate all type of mission profiles.

- 58. 19-golf, sporting activities, driving long distances (over 150 miles)
20-seat adjustments in C-12/UC-35
- 59. 19-Running agrovates it
20-Blank
- 60. 19-Blank
20-CH-47 1950/60's design
- 61. 19-weight lifting (lower back)
20-H47F- Poor lumbar structure
- 62. 19-sports
20-Acceptable
- 63. 19-Running
20-Bottom seat cushion of Lakota is not supportive
- 64. 19-None
20-Seat cushions are uncomfortable and dont provide adequate support to lower back.
- 65. 19-No
20-for the CH47D that the seat is adjustable enough to establish good ergonomics
- 66. 19-exercise
20-CH-47F Seat & Seat cushions need
- 67. 19-Motorcycle riding
20-CH-47. Seat recline is good. Seat cushions are bad.
- 68. 19-exercise-sit-ups
20-CH47D seat is good-tough to stretch out legs in cockpit to relieve the pain
- 69. 19-Blank
20- The cockpit is not long enough; nowhere to put feet when not on controls----

(Note) -SM is 76"

- 70. 19-Blank
20-Blank
- 71. 19-Driving motorcycle
20-I think needs more lumbar support
- 72. 19-Blank
20-Blank
- 73. 19-Blank
20-Blank
- 74. 19-Blank
20-Blank
- 75. 19-Blank
20-Blank
- 76. 19-Exercise, Construction projects
20-The seats in the CH-47F might be fine if we did wear so much gear
- 77. 19-Sit-ups
20-CH-47- Seat material/cushion
- 78. 19-NONE. My physical activity actual help manage my pain

20-Seat material is non-supportive- I used an organ aero seat helped. Seat ht when reclined was to low.

79. 19-N A

20-We forget to study how our backs adjust to the lack of support from our legs while they are held in the air on the pedals.

80. 19-Blank

20-Blank

81. 19-Running, weight training

20-Good

82. 19-Blank

20-Blank

83. 19-Weight Lifting

20-64D, Had to remove back ballistic plate to get comfortable

84. 19-Blank

20-UH-60 A/L Straight seat back frame with no adjustment is frustrating

85. 19-Blank

20-Seat Position in H60 needs 2 to 3 clicks moin (?) aft adjustment

86. 19-Exercise usually makes it better

20-AH-64 had to fly hunched over/ UC35 Angle of seat cannot be adjusted

87. 19-Pt, yard work

20-58D Must remove seat back cushion to fly with armor. Units dont pay for new bottom cushions

88. 19-Blank

20-Blank

89. 19-Kettlebell Workouts Are Helping, Core Strength is key

20-Overall quality is poor. There are numerous off the shelf memory foam products available.

90. 19-Blank

20-UH 60 Better seat cushions and seats that can recline move better lumbar

91. 19-Blank

20-MH65 Very poor seat all around

92. 19-improper lifting

20-Blank

93. 19-Running

20-Good Enough For 1.5 Hours flight only

94. 19-Blank

20-I flew aircraft from 1983-1995. Smaller A/C such as OH58/UH1 required excessive and disproportionate pedal imputs. I firmly believe this was the cause of most of my back pain.

95. 19-sport activities

20-passenger seats in UH60 &C130s are miserable

96. 19-Blank

20-Blank

97. 19-Sit-ups

20-Uncomfortable- Especially OH58. Preventative strengthening/ stretching is critical

98. 19-running in general or impact of running, speed walking

20-Now I am in the 47, I am able to produce more comfort from seat positioning.

More lumbar support would be appreciated.

99. 19-Exercise

20-Seats are terrible, A/C get redesign (H-47 F/G) seats stay the same

100. 19-Sitting at a desk/computer

20-Ergonomics are fine-ALSE is the major contributor

101. 19-Blank

20-Blank

102. 19-Blank

20-Blank

103. 19-Blank

20-Blank

104. 19-Blank

20-Blank

105. 19-Blank

20-Blank

106. 19-Running

20-Blank

107. 19-None. Definitely aviation related

20-Seats suck for both 58D &47. Seats cause discomfort and distract from flying duties.

108. 19-weight lifting with improper form

20-Seats could be more ergonomic

109. 19-running

20-The seats are great when They are new and covered in sheep skin

110. 19-Blank

20-Blank

111. 19-Running

20-C-12: Not very bad. Needs lumbar support, and better tilt back abilitys

112. 19-Ingress/egress through narrow doorway, cabin and cargo area

20-Improved ergonomics in the C-12 have probably reduced the risk of long term back issues compared to the rotor wing cockpit.

113. 19-Blank

20-Blank

114. 19-exercise, weight lifting, hiking

20.C12/RC12- Good; UH60-A,A/L- Poor

115. 19-Blank

20-Blank

116. 19-Blank

20-Army UH-60 seats are not ergonomic at all and over time caused back pain

117. 19-Unknown

20-Blank

118. 19-N/A

20-N/A

119. 19-Not a major contributing factor

20-A/C seats stink! Especially for scout/attack/lift (OH58,AH-6, UH-1, AH-1).
Fixed wing seats are much better, but after 4-6 hrs, still hurt.

- 120. 19-Blank
20-Blank
- 121. 19-Blank
20-UH60 seats should be more form fitting
- 122. 19-driving,
20-crew seats cause my lower pain
- 123. 19-N/A
20-modern A/C are better designed
- 124. 19-Car mechanics-working with hands extended/stooping
20-UH60 seat-refurbish/replace as needed
- 125. 19-Blank
20-Blank
- 126. 19-NA
20-Body armor in 60 seat makes you lean forward
- 127. 19-N/A
20-72 seat lumbar support needs improvement.
- 128. 19-Blank
20-Blank
- 129. 19-exercise, weight lifting
20-outdated however improving
- 130. 19-exercise
20-UH-72 cockpit seats are wonderful as long as cushions, however the MEP station seat is terrible!
- 131. 19-None
20-OH-58, extremely poor lumbar support, have to slouch to fit in aircraft and because seat angle it terrible, access to FLT controls is no issue
- 132. 19-Blank
20-Blank
- 133. 19-Blank
20-Horrible
- 134. 19-Blank
20-Blank
- 135. 19-Weight lifting, Cross fit
20-OH-58D-worst seat ever, but they got rid of the helicopter anyway.
- 136. 19-Blank
20-Im a 58 driver. While flying with body armor I have to remove the back seat cushion and fly with a back lumbar support.
- 137. 19-None
20-Seat's in the OH-58D have improved over the past few years. But still have room for improvement. Biggest complaint is lack of suitable lumbar support. The air-inflated lumbar support 'pop' + break very quickly. I ended up flying with my checklist behind my lower back to provide needed support.
- 138. 19-weight lifting
20-Blank

139. 19-Blank
20-Blank
140. 19-weight lifting, work around house
20-N/A
141. 19-Blank
20-I experiences pain from my lower left back radiating down to the outside of my left knee. After a strength and conditioning program I undertook focusing on core strength and Olympic lifts, I am pain free.
142. 19-Blank
20-Blank
143. 19-Blank
20-C12-need better lumbar support in seats
144. 19-Blank
20-Comfort is junk, but survivable is a huge plus
145. 19-sitting in chairs for extended periods of time
20-None
146. 19-I have stopped doing a lot of recreational activities to try to limit back pain while flying.
20-I'd like to see adjustable angle seat backs incorporated into design and unit physical therapists take an active role in P.T. and preventing pain/injury through core strength
147. 19-weight lifting
20-Oh-58D is not bad as long as there is no body armor worn. The seat bottom needs to be a little thicker for the 6-8 hour missions. Another problem is the air warrior flight gear that puts all the weight on the front of your body. The system is garbage and I call pm air warrior with recommendations but they don't listen.
148. 19-any exercises where you use only your back on impact
20-OH58D-seats are not wide enough so your hips are all thrown out of wack which torqs your back in a weird way.-----(Note)-SM is 76"
149. 19-Airborne operations; long slow runs
20-AH-64D ergonomics are much better when compared to OH-58D.
150. 19-Exercise
20-Combination of OH-58D seats and body armor significantly contributed to my lower back pain. Flying 6+ hour missions with no seat adjustment was dreadful.
151. 19-Blank
20-OH-58 seat bottoms air pocket seats deflated & loss of plungers prevented them from being refilled. This caused the seat to sink lacking sufficient support. Lack of sufficient lumbar support.
152. 19-Blank
20-OH-58D-Too much ALSE in small cockpit w/ armor side pannels
153. 19-Blank
20-Blank
154. 19-Blank
20-UH-60/ seat cushion, angle of seat
155. 19-exercise
20-OH58D- zero continuity of seat foam
156. 19-Blank

- 20-The OH-58 has horrible ergonomics
157. 19-Blank
20-58D seats are in no way ergonomic. Chronic lower back pain among most 58D pilots.
158. 19-yardwork
20-cushions get worn out + never get replaced
159. 19-Blank
20-Blank
160. 19-exercise (running, sit ups)
20-58D-good, Lakota-good, C-12-much better
161. 19-Blank
20-Blank
162. 19-PT
20-OH-58D has horrid seats
163. 19-General posture
20-OH 58D seat do not accommodate for size and weight of combat equiped pilot (Body Armor).
164. 19-Blank
20-OH58D, seat cushions are non-existent. Lumbar cushions are great, however in combat with all the gear, cannot be used.
165. 19-Blank
20-I think that front loading ALSE equipment caused a stoop which resulted in pain. The OH-58 is narrow so the majority of ALSE equipment gets placed on the front of the torso
166. N/A
167. 19-exercise, weight lifting, construction
20-OH-58D has no ability to adjust to the pilot
168. 19-Sitting in unsupportive chairs in classrooms.
20-Sitting left seat in OH-58D puts you in a poor position when on the sight. You are leaning/ hunched over for hours.
169. 19-Mandatory crossfit for PT
20-58D the seat is not ergonomics and very uncomfortable but able to access the flight control with ease.
170. 19-Blank
20-Blank
171. 19-N/A
20-OH-58=Going Away= Needed much better seats
172. 19-Blank
20-The Kiowa Warrior does not have adjustable seats which makes it uncomfortable after a period of time. The position you have to sit to work systems in the left seat can cause strain as well, particularly on the lower back.
173. 19-Extensive standing on hard surfaces/ Long periods+ distances of exercise+ running
20-OH58D=seats of poor quality/ Angle- not adjustable + low cushion/ support.
174. 19-Blank
20-OH58D seats are CRIMINALLY Bad

175. 19-Blank
20-Blank
176. 19-Blank
20-Poor ergonomic design in seating/ lumbar OH-58 D!
177. 19-None
20-OH-58D-Too small.
178. 19-Blank
20-Not sure that there is an easy solution with the seat ergonomics, but more should be done to monitor and educate pilots on back health, exercises, stretching, check ups etc...
179. 19-weight lifting, poor posture
20-OH-58D-seat height and length of seat. Body armor and equipment with limited place to put them.
180. 19-Blank
20-Blank
181. 19-Blank
20-Blank
182. 19-Farming
20-Poor aircraft seat design
183. 19-Blank
20-Blank
184. 19-Sit-ups, too much TV (sitting on couch, etc)
20-It took me about 3 ½ years of flying to get comfortable. Now I'm ok in a 58D.
185. 19-Guess it's possible any of the activities above...I still do all of them
20-OH58 is going away so it doesn't matter. However, why aren't the Maxo face shields issued to every aviator?
186. 19-Blank
20-Blank
187. 19-weight lifting, sprints
20-OH58D-the quality of the seat cushion are very poor. After about 1 month in combat they are completely worn in. This combined w/ the heavy combat gear makes flights >2 hrs painful.
188. 19-Blank
20-UH60 A/L my seat in my car is better and im sure it costs less.
189. 19-Headache
20-AH 64D seats need to be designed to better accommodate pilots for back issue.
190. 19-Blank
20-(AH-64) Seats are extremely uncomfortable and the cushions are very weak.
The ALSE vest and body armor are very front-heavy.
191. 19-yard work
20-Blank
192. 19-Blank
20-64 seats are very uncomfortable. Most older pilots I know in the 64 community have chronic back pain.
193. 19-Blank
20-Get rid of the heavy survival vest and body armor!!

194. 19-Blank

20-In the FS of an AH-64D, the gunner generally will lean forward to use the TEDAC handles plus body armor causing the aviator to bend over. In both seats flying causes lower back pain due to lack of adequate/ adjustable lumbar support while controlling the cyclic, especially on long flights with body armor.

195. 19-Blank

20-Blank

196. 19-Blank

20-Blank

197. 19-Golf, weight lifting.

20-Apache seat padding needs to be better.

198. 19-Blank

20-Blank

199. 19-weight lifting

20-Hard seats and poor cushion in the AH 64 make my ass go numb after about 2 hrs and lower back starts to hurt.

200. 19-Bicycle riding, hiking, exercise

20-UH60 seat backs too far had to removed to fly combat loaded

201. 19-Blank

20-Head tends to lean forward and the weight and room with full combat gear

202. 19-N/A

20-AH-64D/E Seat cushion, angle, position of cyclic could all use revision. Most importantly-weight of helmet, goggles & gear on vest effect negatively for back/ neck pain.

203. 19-Blank

20-AH-64 D/E overall not bad, believe the angle of the seat/ upper body after air warrior vest and armor are added contribute to lower back ache.

204. 19-Dirt bike riding

20-AH-64E---Can't rate quality because there is no ergonomics to evaluate.

205. 19-weight lifting

20-Little to no thought is put into ergonomics of seat design

206. 19-Blank

20-Horrible

207. 19-weight lifting

20-Blank

208. 19-Long distance running, heavy lifting

20-Weight of Air Warrior ensemble in concert with seat angle (back seat) makes long term operation in a stooped position mandatory.

209. 19-Blank

20-flying long hours in combat gear with armor on chest I think has caused pain. I do however think that seat improvements are needed

210. 19-Falls

20-AH-64D seats with near verticle backrest fatigues lower back after 2 or so hrs.

211. 19-Sports, exercise, weight lifting

20-Seats need improved for comfort dramatically

212. 19-Carrying any loads, helmet bags to A/C

20-AH64D

213. 19-Running
20-Not too bad, would like more lumbar support
214. 19-exercise, picking up kid
20-Blank
215. 19-Blank
20-Blank
216. 19-None
20-64D very confined concept
217. 19-Blank
20-not to bad, with armor on its a little worse but ok overall
218. 19-Blank
20-Blank
219. 19-Blank
20-Blank
220. 19-Blank
20-Blank
221. 19-Blank
20-AH64D front & back seats lead to hunching over
222. 19-Blank
20-I understand + am realistic with the constraints of the budget and priorities of survivability. Back pain is to be expected and more aviators should make diet/ exercise + stretching a priority.
223. 19-Running, golfing, tennis, Frisbee
20-The lack of ability to adjust seat angles and proximity to flight controls need to be improved.
224. 19-weight lifting, exercises
20-AH-64 seat causes you to lean forward especially w/ body armor. This is especially true for front seat since controls forward. With body armor it was normal practice to remove back cushion and double bottom cushion by putting back cushion on top.
225. 19-Driving long distance, flying, physical exercise (ie. situps)
20-Most Army aircraft seating is not ergonomically design, this does not elevate the cause of further back pain injuries.
226. 19-Blank
20-AH64 front seat hurts me the worst. With body armor and combat load, I couldn't fit with seat cushions. The oregon Aero thin seat backs worked but still didn't provide lower back support. The heavy combat load made me fly hunched over for most of the flight. that with the vibrations caused days where it was tough to get out of bed and do daily tasks.
227. 19-improper chairs at work
20-AH-64 square seats-standard comments
228. 19-Blank
20-AH 64D. The seat will not adjust and there is not lower back support. Also, while in combat, the weight of our gear is in the front of our body which causes a leaning forward and back pain.
229. 19-Blank

20-I believe the seats are very hard and uncomfortable, however, the mission time, flight time (time needed to sit in an a/c for long missions) significantly contributes. E.g. 9 hour AH64 flights

230. 19-Blank

20-Poor. 99% of all AH64 pilots sit hunched over to reposition themselves to accomodate all worn gear ie body armor, overwater gear.

231. 19-Blank

20-AH64 provides sufficient room in the back seat, however the front seat is too restrictive with combat load. Back rest has to be removed for space.

232. 19-exercise, weight lifting, driving

20-AH64 terrible lumbar support doesn't fit to the bottom cushion, use on manufacturer

233. 19-Blank

20-Front seat in AH64D has poorly designed/ bad angle for back portion of seat. Seats in booth stations very uncomfortable and don't seem to provide any support.

234. 19-weight lifting

20-Blank

235. 19-Crouching sitting angle of seats with combat load upper back pain

20-Ergonomics in military aircraft is null with regards to seat position and comfort.

236. 19-Blank

20-Blank

237. 19-Blank

20-Very poor in AH64D. No lumbar support. Seat cushion too short.

238. 19-poor posture

20-poor. All the aspects you mentioned and I indicated in q. 13 hit the nails on the head.

239. 19-Blank

20-The use of TEDAC in front AH-64 required me to slouch or rather look down which, in effect made me slouch. I had to find ways to recline as time and mission enabled.

240. 19-Weight lifting, yard work

20-AH-64D-minimal Space, body armor not tailered to airframe

241. 19-Ruck march/ cut sleeping

20-Blank

242. 19-Heavy weight

20-AH64 sits leaning too far fwd in flight

243. 19-Blank

20-The thinner back cushion is good allows the pilot to sit upright the bottom cushion is only good for 1 hour

244. 19-None

20-AH-64-good ergonomics AH-6-vertical seat back creates back problems for nearly all AH/MH-6 pilots

245. 19-weight lifting, sports

20-poor, poor seat cushions

246. 19-Blank

20-Poor seat cushions and seat angle

247. 19-None

- 20-I cant think of anything other than better cushions
248. 19-Blank
20-AH-64 more leg room or cabin height
249. 19-Blank
20-The body armor we wear combined with the angle of the seat puts a lot of strain on our lower back.
250. 19-Blank
20-Blank
251. 19-Blank
20- I think AH64 ergonomics are good but combat ALSE gear ruins them!
252. 19-Running over 2 miles
20-Seats have never bothered me, it was the extra gear
253. 19-Blank
20-Seats are not designed well
254. 19-Blank
20-AH64 the struts providing crash protection have not been redesigned since it was first introduced.
255. 19-NA
20-NA
256. 19-Blank
20-Blank
257. 19-All
20-Blank
258. 19-Exercise and hereditary reasons
20-OH-58 A/C—Poor materials for seat (Stretched Webbing) AH-64 A and D—Inadequate seat cushioning, although they have gotten better
259. 19-Blank
20-Blank
260. 19-Blank
20-Blank
261. 19-Blank
20-Blank
262. 19-Blank
20-Blank
263. 19-Blank
20-Blank
264. 19-Blank
20-Blank
265. 19-Blank
20-Blank
266. 19-Blank
20-Blank
267. 19-Blank
20-Better lumbar support, better/adjustable angle of seat
268. 19-none
20-UH60 A/L crew chief seats are HORRIBLE-cabin seats are same

269. 19-Blank
 20-Blank
 270. 19-Snow boarding
 20-UH-60 seat is 90° and leans forward while in flight causing all ALSE weight to hang off back & shoulders
 271. 19-Blank
 20-position and lack of adjustment for CE seats in UH60L
 272. 19-Blank
 20-Seats are not built for taller crewmembers.----(Note)—SM is 75 ½ “
 273. 19-Blank
 20-Blank
 274. 19-Blank
 20-UH60-Pilots' seats are leaned forward during flight. No adjustment for tilt while flying.
 275. 19-Ruck Marches
 20-As a back seater I rarely “sit back” in my seat so a lumbar support is irrelevant. But being able to adjust seat height and a better seat cushion would definitely add to my comfort on long missions.
 276. 19-Blank
 20-Blank
 277. 19-Exercise + normal household work
 20-UH-60-None to note
 278. 19-Blank
 20-Blank
 279. 19-Blank
 20-UH60 A/L Never has been able to get comfortable with the back rest
 280. 19-Blank
 20-They are not very ergonomic. It is more like sitting against a brick wall
 281. 19-Long distance running
 20-Poor ergonomic design that could be significantly improved
 282. 19-Blank
 20-Blank
 283. 19-Blank
 20-60 seats are very rigid + dont allow for padding when armor is worn.
 284. 19-cycling
 20-Blank
 285. 19-Blank
 20-UH 60 Oregon Aero seats are a huge improvement over the standard cockpit
 seats
 286. 19-Sitting too long
 20-Need to be able to adjust it more
 287. 19-Previous L2 Fracture. Prior to aviation duties
 20-With ALSE equipment (for combat), The UH-60 is very difficult to maintain a neutral spine while still accessing the controls.
 288. 19-Situps, can be sometimes uncomfortable

20-Not being able to adjust during long flights. Staying confined to one position makes it painful.

289. 19-WT lifting, skydiving, rucksack marches, infantry life

20-Blank

290. 19-road marches and formations

20-UH60-terrible seat design

291. 19-Weight lifting

20-UH-60A/L/M needs active support system, passive systems do not help long term vibration attenuation

292. 19-Blank

20-The seats are bad.

293. 19-Running

20-UH-60 (A-L) seat angle is awful. The survival vest is overweight and places extra weight on neck and shoulders.

294. 19-Wake boarding, alpine skiing, weight lifting

20-Quality=Low M Model UH-60 is much better with blow up bladders. Legacy acft is terrible

295. 19-Construction projects

20-UH-60M seats I realize is a lot more comfortable

296. 19-exercise

20-seat cushions are not bad but never get new ones

297. 19-exercise

20-H-60 A/L seats adequate w/o body armor/ALSE Had to remove back rests in combat for cyclic restriction

298. 19-Blank

20-Blank

299. 19-Blank

20-UH-60 A/L Long FLT times, would be nice to adjust seat for ea crew member

300. 19-Sometimes I sleep on crappy hotel mattresses

20-UH-60L

301. 19-Standing on hard surfaces for long periods of time.

20-H-60M the lack of cushion on lower seat cushions causes leg + glut pain causing pilots to shift weight in seat. Leads to increased back pain. H-60 Not being able to move the seat far enough back w/ body armor on causes the need to remove back cushion/ lumbar support.

302. 19-Blank

20-UH100 A/L zero lower back support

303. 19-Working (bent over) in the garage at home.

20-UH-60 A/L seat angle too upright, crappy lumbar support, visibility poor causing pilots to lean forward over the cyclic for visibility improvement

304. 19-Weight Lifting, Motorcross

20-UH60 is like sitting on a park bench.

305. 19-None

20-None

306. 19-Blank

20-Seats too straight up need to recline slightly-No need to wear air warrior gear in garrison, cell phones replace CSELs in CONUS. First aid kits in aircraft. Save our backs while we're home.

307. 19-Poor posture

20-Decent seat cushions tend to become unsecure (slide) in UH-60.

308. 19-None

20-UH-60 w/ gear is terrible

309. 19-weight lifting, long runs

20-UH60 pilot seating bad angle for high speed mode of flight. Show signs of degenerative joint disease in lower back via MRI

310. 19-running, situps, lifting

20-UH-60-adequate, much better with oregon aero seats

311. 19-wearing of combat gear exsesive loads carried

20-seat to airframe clearance in back of UH-60, knees twist fore or aft during flight

312. 19-Blank

20- UH 60: look into being able to lean the pilots seats back.

313. 19-working in the yard at home aggravates it.

20-My back hurt consistently in the UH60 A/L, since transitioning to the UH60M my back pain has reduced tremendously.

314. 19-exercise, weight lifting, road march

20-seats on the aircraft are horrible the ones in the back UH60M are even worse.

Need to wear less gear or allow pilots to stretch out more often

315. 19-golf

20-Lighter NVG, HUD, ALSE, better cushion support.

316. 19-Blank

20-Blank

317. 19-Blank

20-Blank

318. 19-Blank

20-seat are not adjustable enough, cushions are worthless H60L

319. 19-Blank

20-Blank

320. 19-running

20-Blank

321. 19-Blank

20-Blank

322. 19-Blank

20-Blank

323. 19-Blank

20-H-60 need better seat adjustment (reclinement) to adjust to the new aviator.

324. 19-Blank

20-Need better choices for lumbar supports

325. 19-Blank

20-Blank

326. 19-running

20-UH60L cause me to lean forward/ hunch over all the time seat is too vertical and I can't lean or adjust with seatbelt on.

327. 19-Blank

20-Sats are NOT ergonomic

328. 19-Blank

20-Blank

329. 19-lifting or running

20-there is none. The Army does not care about our backs.

330. 19-None

20-UH60M seats seem better than UH60 A/L. The UH60 A/L are not comfortable and reduce mission performance

331. 19-none

20-UH-60 A/L seat angle (back is near vertical) lack of lumbar support. Uh-60M-better seat angle, adjustable lumbar support needs to be more robust.

332. 19-Amount of flight related gear carried to + from Acft

20-Blank

333. 19-Weightlifting

20-TH-67, seat cushions worn out, OH-58, UH-60 weighted flight gear/armor

334. 19-poor posture habits

20-Blank

335. 19-Exercise/ weight lifting & little stretching

20-Blank

336. 19-Blank

20-Blank

337. 19-Blank

20-Blank

338. 19-Blank

20-UH-60 A/L/M lumbar support is not aggressive enough. Especially when wearing body armor.

339. 19-Weight lifting

20-We wear a lot of gear that causes me to slouch forward when flying. Bad posture due to angle of seat.

340. 19-exercise, weight lifting, weekend warrior activities

20-Uh-60 seats weren't designed w/ the gear we wear

341. 19-Blank

20-The amount of body armor we have to wear during flight I think caused the majority of my issues. While the seat cushions are less than desirable they can be improved.

342. 19-exercise, cutting grass

20-UH60 A/L-angle of seats coupled with body armor need much attention

343. 19-Blank

20-H-60 seats only adjust vertically or fore/aft. I have seen seats installed in H-60 aircraft that were able to adjust sitting angle also. All cushions I have ever sat on were extremely hard and uncomfortable, even the Oregon aero seat cushion. NO lower back support.

344. 19-Blank

20-(UH60A/L)-The seats were designed for survivability, not comfort. Lumbar support & adjustability greatly add to the discomfort.

345. 19-Blank
20-Blank
346. 19-Blank
20-UH-60 A/L seat not designed for comfort. Oregon aero seats help however, I believe most of my back pain is from worn gear (air warrior vest + pouches, body armor)
347. 19-Running causes sever back pain (did not used to before flight)
20-UH-60 ergonomics are not a consideration in acft design
348. 19-weight lifting, exercise
20-Uh-60 has restrictive head movement capability, i.e. with helmet and battery pack on the headset pushes my head forward instead of allowing me to sit straight up
349. 19-Blank
20-Blank
350. 19-N/A
20-UH-60 terrible lumbar support and angle
351. 19-High impact activities (ie long distance running)
20-Tilt seats help tremendously to relieving back pain
352. 19-Schinling exercise reduces back pain
20-Blank
353. 19-Sports
20-UH-60 crew chief seats don't have enough cushion
354. 19-Blank
20-Blank
355. 19-Blank
20-UH-60 crew chief seats are horrible TH-67 seats need to be able to adjust
356. 19-Blank
20-Blank
357. 19-House paining, exercise
20-UH-60 A/L seat cushion need improvement for lumbar support.
358. 19-sit ups
20-The angle of Blackhawk seats are to upright. With gear on, can't sit up right.
Always slumped over
359. 19-Blank
20-UH-60M seats/cushions are much better than UH-60L. AUCS also greatly reduces back pain in a UH-60M
360. 19-Work on car or motorcycle while laying on my back.
20-For UH-60 A/L & HH-60L better seat cushions would help for longer periods better support and adjustable support would be better
361. 19-Exercise/ weight lifting/ general work
20-It seems not as well thought out compared to commercial aircraft
362. 19-bike riding, weight lifting
20-UH-60-Not bad without armor and never seat cushions RC-12-Aweful, seat does not adjust easily to comfortable position. Controls are not well placed, pedal adjustment difficult, seat very uncomfortable.
363. 19-Just simply over-exursion of any activity.
20-I do feel the UH60 seats are overall a good design. I think some pain due to weight of helmet/NVGs/etc. can cause some neck and back stress.

364. 19-standing up for long periods of times.
 20-UH-60 needs a better lumbar support.
365. 19-In Iraq the duration (6-8 hrs flt time) killed me
 20-UH60 seat goes to low + I don't like sitting up in the seat legs to close to the floor
366. 19-running, sit ups
 20-ergonomics would be fine without ALSE gear/ body armor
367. 19-weight lifting
 20-UH-60M ergonomics/seats greatly improved over UH-60 A/L
368. 19-None
 20-Distance between flt controls and seat requires stooping
369. 19-Packing heavy boxes
 20-wondergel.com pad saved my back.
370. 19-Blank
 20-UH60, from a scale of 0-10 I would say the aircraft is a 5. seats could be better designed to aid back pain.
371. 19-Weight lifting-Running
 20-UH-60-the weight of gear pulling the body forward. I believe is the cause of my back pain.
372. 19-Running
 20-UH60 lack of leg room----- (Note) SM is 76"
373. 19-Running, Pushups, sit ups, weight lifting
 20-poor lumbar support, ALSE equipment
374. 19-Blank
 20-Seats are ill designed, along with the old cushions.
375. 19-carrying gear to and from the aircraft
 20-Blank
376. 19-had to modify sleep position
 20-UH 60 seats lack of padding I noticed sciatic pain corresponded to the seat I was sitting in + side of my body towards center of aircraft. Sitting right seat= left buttock + leg pain. Is seat higher towards center console?
377. 19-Blank
 20-Blank
378. 19-Sports, construction in youth
 20-For my size (note 75"), the UH-60 has a terrible seat angle, no leg room, and a harness that pulls down and forward on the shoulders
379. 19-exercise, weight lifting, construction projects, weekend warrior sports activities like to be active
 20-H60-more room, seat needs to adjust farther back angle of seat could be more—
 (Note) SM is 77"
380. 19-Blank
 20-Blank
381. 19-Blank
 20-I fly the UH-60 A/L, the seats are not the worst pain in the world, but after 3 hours of flight time, my lower back/ leg starts hurting a lot.
382. 19-Blank

- 20-Blank
383. 19-Everything, age, sports, diet
20-Lumbar & recline. If I could recline it would lessen my soreness.
384. 19-running + situps + long periods standing
20-H-60 seat cushions suck need skydex
385. 19-Running weight lifting ruck
20-Uh-60 seating sucks need lower lumbar support
386. 19-Blank
20-UH60-some seat cushions feel like they were installed in the original
- Blackhawk**
387. 19-weight lifting
20-UH-60 need lumbar support.
388. 19-Blank
20-UH-60 L seat cushion are terrible. Provide no lumbar support especially in combat with a loaded vest.
389. 19-exercis, weigh lifting
20-Better back support on seats
390. 19-Weight lifting
20-I always remove seat back cushions for extra leg room. Helps the back alot
391. 19-Blank
20-Blank
392. 19-Diagnosed in 2001 w/ spondylolysis (sp?) but no longer experienced regular pain after 2004. Not sure why pain went away. I've been a F/W pilot since 2005. (Thankfully)
20-UH-60 seat is terribly uncomfortable and restrictive. Clearly the seat was designed from a crash attenuation point of view rather than comfort during mission duration.
393. 19-Blank
20-Units need to be more active in replacing worn seat cushion.
394. 19-General exercise
20-Most crewmembers went to be hunched over to see over the console or see the instruments better resulting in poor seated posture.
395. 19-Blank
20-UH-60 A/L/M. M is def better w/ AVCS +adjustable seats
396. 19-Blank
20-Blank
397. 19-Blank
20-Blank
398. 19-Blank
20-Blank
399. 19-Sleeping away from home (not a quality mattress)
20-Could be better. It's built for efficiency, not comfort.
400. 19-Buddy carry during PT, push-ups, Isometric PT activities
20-UH-60 A/L/M seats, lumbar support, and padding are not sufficient
401. 19-none
20-seat cushions wear out quick and become flat and provide little cushioning.
402. 19-none

20-The seats should go back farther in a UH-60---overall more options for seating configurations would be helpful

403. 19-construction projects, weekend sports, household chores, sex, exercise and driving

20-seats are cheap and do not allow for adjustment to different body compositions. Body armor can make difficulties as part of ALSE to the detriment of the wearer and requiring the removal of the back padding. The difficulty was with movement of the cyclic.

404. 19-weight lifting

20-UH 60 crew seat extremely uncomfortable and awkward

405. 19-Blank

20-Blank

406. 19-Blank

20-Blank

407. 19-Blank

UH-60-Cabin not enough leg room/ head room----- (note) SM is 76"

408. 19-Blank

20-Blank

409. 19-playing w/ kids

20-UH-60 are not ergonomic for long flights. Lack adjustments.

410. 19-Weight lifting, exercise

20-The seats have a simple fix but early investments need to be made to preserve backs of aviators and crews.

411. 19-Motorcycling

20-Blank

412. 19-golf, softball

20-With all the technology out there it is time for ergonomic improvement.

413. 19-exercise-sit ups

20-I find that I am forced to hunch forward when flying & it is difficult to lean back b/c of the gear I'm wearing.

414. 19-exercise, weight lifting

20-H-60 It would help a lot if the seat was tilted to the rear a bit.

415. 19-Blank

20-In CONUS non-deployed I believe the air warrior ensemble is too heavy.

Different areas should require survival ensembles. Use the coast guard as an example.

416. 19-pushups, standing long periods

20-Blank

417. 19-Blank

20-Upkeep of seat condition

418. 19-Weight lifting,

20-When wearing armor I cannot fly with the stock seat cushion in, it causes an aft cyclic restriction. The thin Oregon Aero seat is great but not all units have or will purchase them

419. 19-None, run mostly which neither improves or worsens condition

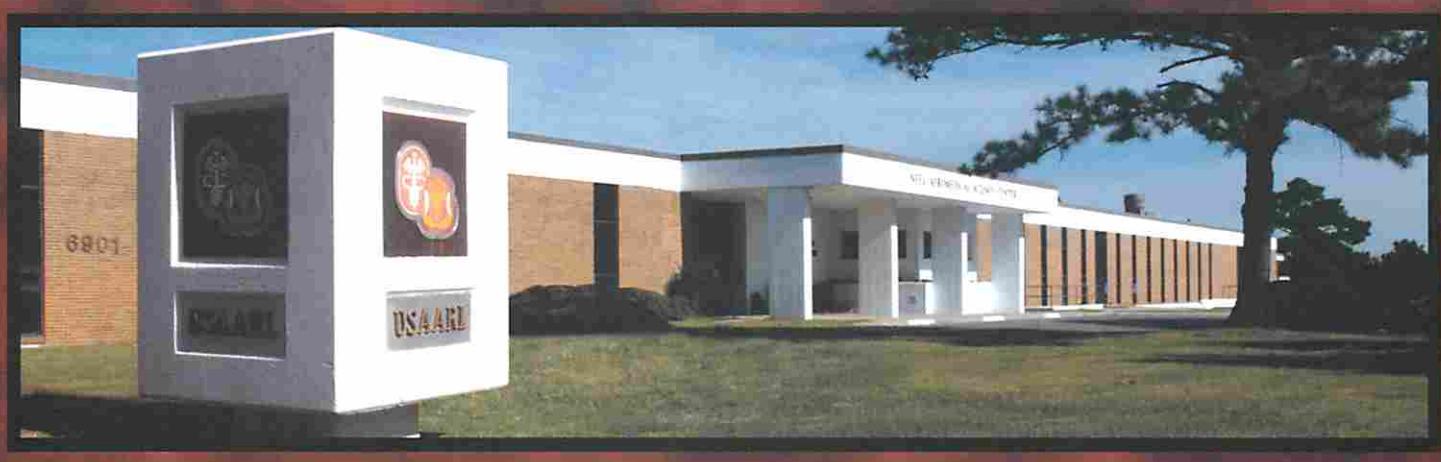
20-UH-60 A/L basic seat/back cushions inadequate. Oregon Aero products provide better support

420. 19-try to limit back use

20-its all the gear and weight on your back!! Poor seat/lumbar support NVG's weight on neck

- 421. 19-Blank
20-Blank
- 422. 19-Exercise/Army PT
20-Its not made for pilots its made for an army contract
- 423. 19-Blank
20-Blank
- 424. 19-Blank
20-Lack of lumbar support is major problem-also seat height
- 425. 19-Blank
20-UH60 seats are terrible
- 426. 19-Blank
20-Blank
- 427. 19-Blank
20-60 with the seat back in there is a lack of aft cyclic movement
- 428. 19-Blank
20-angle between seat and flight controls causes "the hunch"
- 429. 19-Blank
20-H-58-horrible. UH60 A/L- ok w/o combat gear angle of back to controls bad.
UH-60 Mike-slightly better-same problem w/ combat gear. No lumbar support or angle adjustment.
- 430. 19-Paratrooper 96-99
20-I have not been in a cockpit in ~11 years
- 431. 19-Exercise, Airborne operations
20-Blank
- 432. 19-Mech. Infantry (Bradley Gunner Driver) for 5 years
20-Crew chief seat in all AC are uncomfortable
- 433. 19-situps
20-Blank
- 434. 19-Blank
20-Existing condition is aggravated by the UH60 seat shape combined with body armor and aircraft vibration. Condition is ittermittent and onset is often sudden.
- 435. 19-Blank
20-Blank
- 436. 19-N/A
20-Seats on cabin FOL UH-60 L are a bit small to crew.
- 437. 19-Blank
20-Blank
- 438. 19-Blank
20-Blank
- 439. 19-Blank
20-Blank
- 440. 19-Blank
20-Blank
- 441. 19-Blank

- 20-Blank
 - 442. 19-Blank
20-Blank
 - 443. 19-Blank
20-Blank
 - 444. 19-Blank
20-Blank
 - 445. 19-Ab workouts + core exercises
20-nothing specific
 - 446. 19-Blank
20-Oregon Aero seats seem to be best out there. Should be standard in every aircraft
 - 447. 19-Blank
20-Blank
 - 448. 19-Blank
20-As a shorter aviator, the ability to raise my collective/ cyclic with my seat for both improved vision & FC access would be great----(note) SM is 67"
- 449-468. Questions 19 and 20 were left blank



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